RE-CODE DCM (search Objectives and ommon ata lements for egenerative ervical yelopathy): A Consensus Process to Improve Research Efficiency in DCM, Through Establishment of a Standardized Dataset for Clinical Research and the Definition of the Research Priorities

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Abstract: Study Design ixed-method consensus process. Objectives egenerative cervical myelopathy (DCM) is a common and disabling condition that arises when mechanical stress damages the spinal cord as a result of degenerative changes in the surrounding spinal structures. RECODE-DCM (search Objectives and ommon ata lements for egenerative ervical yelopathy) aims to improve efficient use of health care resources within the field of DCM by using a multi-stakeholder partnership to define the DCM research priorities, to develop a minimum dataset for DCM clinical studies, and confirm a definition of DCM. Methods his requires a multi-stakeholder partnership and multiple parallel consensus development processes. It will be conducted via 4 phases, adhering to the guidance set out by the COMET (Core Outcomes in Effectiveness Trials) and JLA (James Lind Alliance) initiatives. Phase 1 will consist of preliminary work to inform online Delphi processes (Phase 2) and a consensus meeting (Phase 3). Following the findings of the consensus meeting, a synthesis of relevant measurement instruments will be compiled and assessed as per the COSMIN (Consensus-based Standards for the Selection of Health Measurement Instruments) criteria, to allow recommendations to be made on how to measure agreed data points. Phase 4 will monitor and promote the use of eventual recommendations. Conclusions ECODE-DCM sets out to establish for the first time an index term, minimum dataset, and research priorities together. Our aim is to reduce waste of health care resources in the future by using patient priorities to inform the scope of future DCM research activities. The consistent use of a standard dataset in DCM clinical studies, audit, and clinical surveillance will facilitate pooled analysis of future data and, ultimately, a deeper understanding of DCM.

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RE-CODE DCM (*RE*search Objectives and Common *D*ata *E*lements for *D*egenerative *C*ervical *M*yelopathy): A Consensus Process to Improve Research Efficiency in DCM, Through Establishment of a Standardized Dataset for Clinical Research and the Definition of the Research Priorities

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Abstract

Study Design: Mixed-method consensus process.

Objectives: Degenerative cervical myelopathy (DCM) is a common and disabling condition that arises when mechanical stress damages the spinal cord as a result of degenerative changes in the surrounding spinal structures. RECODE-DCM (*RE*search Objectives and *C*ommon *D*ata *E*lements for *D*egenerative *C*ervical *M*yelopathy) aims to improve efficient use of health care resources within the field of DCM by using a multi-stakeholder partnership to define the DCM research priorities, to develop a minimum dataset for DCM clinical studies, and confirm a definition of DCM.

Methods: This requires a multi-stakeholder partnership and multiple parallel consensus development processes. It will be conducted via 4 phases, adhering to the guidance set out by the COMET (Core Outcomes in Effectiveness Trials) and JLA (James

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Lind Alliance) initiatives. Phase 1 will consist of preliminary work to inform online Delphi processes (Phase 2) and a consensus meeting (Phase 3). Following the findings of the consensus meeting, a synthesis of relevant measurement instruments will be compiled and assessed as per the COSMIN (Consensus-based Standards for the Selection of Health Measurement Instruments) criteria, to allow recommendations to be made on how to measure agreed data points. Phase 4 will monitor and promote the use of eventual recommendations.

Conclusions: RECODE-DCM sets out to establish for the first time an index term, minimum dataset, and research priorities together. Our aim is to reduce waste of health care resources in the future by using patient priorities to inform the scope of future DCM research activities. The consistent use of a standard dataset in DCM clinical studies, audit, and clinical surveillance will facilitate pooled analysis of future data and, ultimately, a deeper understanding of DCM.

Keywords
cervical, myelopathy, OPLL, spondylosis, disc herniation, cervical stenosis, protocol, outcome, dataset, Core Outcomes in Effectiveness Trials (COMET), James Lind Alliance (JLA), research priorities, Delphi, consensus, audit, surveillance, common data elements (CDE)

Introduction

Degenerative cervical myelopathy (DCM) is a common and disabling disorder. It arises when degenerative changes in the surrounding spinal structures exert mechanical stress on the spinal cord and trigger a progressive injury.[1] Such degenerative changes include disc herniation, osteophyte formation, ligament hypertrophy, or ossification.[2] Patients may initially experience minimal symptoms,[3,4] but subsequently often develop pain, sensory deficits especially affecting their hands and feet, spasticity, imbalance, bladder symptoms, and experience frequent falls.[1] Left untreated DCM can lead to spastic tetraparesis.[5] A recent study investigating quality of life in DCM patients indicated they suffer among the worst SF36 health scores of all chronic diseases.[6]

Due to widespread underdiagnosis, the true incidence and prevalence of DCM is unknown. Current epidemiological studies quote the lifetime prevalence of DCM in the region of 0.5/1000.[7] However, indirect experience suggests this is an underestimation.[1] For example, in a recent study of 181 healthy volunteers aged between 40 and 80 years, radiological features of DCM were seen in 59%, and diagnosis of DCM had been made in only 1% of cases.[3] Observational studies have demonstrated that up to 22% of people with asymptomatic spinal cord compression will go onto develop DCM.[8,9] As a degenerative pathology, the incidence is expected to rise with aging populations.

Surgery aimed at decompressing the spinal cord is the mainstay of treatment.[10] This is able to induce limited improvements across a number of outcome domains.[11] However, owing to the limited intrinsic regenerative capacity of the spinal cord,[12] few patients make a complete recovery.[13] As a consequence, most patients suffer life-long disability.

Over the past 20 years, clinical research on DCM has significantly increased.[14] This has clarified some basic tenets with regard to the understanding and treatment of DCM, but many questions remain unanswered, including fundamental aspects of DCM pathology, the contribution of genetic predispositions, as well as mechanisms by which DCM could be prevented and recovery improved.[15,16]

Lack of Patient Involvement in the Design of Research Risks It Not Addressing Patient Needs

In recent years, the importance of involving patients in the design of research has become apparent. The term "research wastage" was coined for research that does not result in health care benefits for patients. In their seminal series, Chalmers et al estimated that of the $240 billion invested in North American health care research during 2010, 85% was misspent.[17] They identified a number of key contributory factors, including (1) missing or ineffective research synthesis (eg, systematic review), leading to research duplication, and (2) misalignment of researcher and end-user objectives. These are equally applicable with DCM.

Inconsistent Reporting of Research Findings Compromises Research Synthesis

Efficient research synthesis requires 3 things: matched variables, reported in the same manner, and easily identifiable studies. Recent systematic reviews indicated that clinical trials in DCM do not use the same outcome measures or reporting style.[18] While some discrepancies can be overcome by acquiring the original data, this is time-consuming, rarely straightforward, and often not possible.[19] Moreover, the interpretation of any pooled outcomes must also consider the comparability of the studied population and the trial methodology. In DCM, this is particularly pertinent due to the recognition that baseline characteristics are important predictors of response to treatment.[20,21] This reporting is also inconsistent.[22] Consequently, studies are often excluded.[11]

DCM Lacks an Index Term That Enables Efficient Literature Searches

DCM has recently been introduced as an umbrella term for a number of degenerative conditions of the spine that result in cervical myelopathy.[23] While there has been good uptake within the medical literature since its introduction, cervical

Table 1. RECODE-DCM Definitions[a].

Acronym	Definition	
DCM	Degenerative cervical myelopathy	—
MeSH	Medical Subject Heading	MEDLINE is a database of life science publications. MeSH are hierarchically organized terminology for indexing and cataloguing its contents, to facilitate search.
JLA	James Lind Alliance	http://www.jla.nihr.ac.uk/—A nonprofit initiative to support and oversee the establishment of healthcare research priorities.
PSP	Priority Setting Partnership	This process is carried out using a collaborative approach of relevant stakeholders referred to as a PSP.
OMERACT	Outcome Measures in Rheumatology	www.omeract.org—An initiative supporting the development of consensus in outcome measurement for arthritis.
COMET	Core Outcome Measures in Effectiveness Trials	http://www.comet-initiative.org/—A UK based organization supporting the development of COS.
NINDS	National Institute for Neurological Disorders and Stroke	www.commondataelements.ninds.nih.gov—NINDS is the neurological arm of the National Institute for Health, United States. They pioneered and continue to support CDEs for neurological disorders.
COS	Core Outcome Sets	A set of agreed *outcome* variables and their measures to be reported in clinical trials.
CDE	Common Data Elements	A set of agreed variables to be measured and reported in clinical trials
CMS	Core Measurement Set	A set of agreed tools used to measure outcomes or other data elements.
COSMIN	COnsensus-based Standards for the selection of health Measurement INstruments	http://www.cosmin.nl/—The COSMIN initiative aims to improve the selection of health measurement instruments, by ensuring instruments have undergone appropriate evaluation.
GRADE	Grading of Recommendations Assessment, Development and Evaluation	http://www.gradeworkinggroup.org/—A working group who developed a transparent approach to grading quality (or certainty) of evidence and strength of recommendations.
eDELPHI	Electronic DELPHI	An electronic system used to deliver the Delphi process over the internet.

[a] This consensus field is rich with acronyms, often bearing close resemblance in sentiment but different precise meaning. This table lists the acronyms used in this protocol, including a summary (with link out resources where appropriate) of their meaning.

myelopathy in its various etiologies lacks a recognized ICD (International Classification of Disease) diagnostic code, Medical Subject Heading (MeSH) for MEDLINE, or equivalent grouping index term. Moreover, key search terms are not unique: myelopathy can be caused by a range of other conditions, degenerative pathology of the spine can occur in the absence of DCM, and the surgical treatments can be applied to other spinal conditions. This complicates literature searches and research synthesis.[24]

Limited Involvement of Patients in DCM Research Design May Lead to Misalignment of Research

A recent survey, conducted through Myelopathy.org, an international charity for those working with or directly affected by DCM, explored the recovery priorities of individuals suffering from DCM. The responses to the questionnaire indicated that next to walking and hand function, which are often used as a study outcomes,[18,25] the number one priority was the resolution of pain (Davies et al, unpublished data). In contrast to patient responses, pain is however infrequently assessed in DCM trials and reported by less than 25% of studies.[18,22]

In order to enable more efficient research synthesis and to align research with patient needs, global initiatives have been formed that aim to develop standards for researchers. These processes use a multi-stakeholder consensus process to solicit knowledge, experience, and judgement from stakeholders with a broad range of direct interest on a particular issue and derive shared and relevant agreement. Stakeholders are defined as "individuals, organizations, or communities that have a direct interest in the process and outcomes of a project, research or policy endeavor."[26]

Definition of Core Outcome Variables Aid Research Quality and Synthesis

Organizations such as the Core Outcome Measures in Effectiveness Trials (COMET) Initiative promotes the definition of Core Outcome Set (COS) and additional data points (Core Data Elements [CDE]) (Table 1). Often standards also define how data points should be measured, referred to as a Core Measurement Set (CMS).[27-29] Apart from promoting comparability among studies, such core outcome sets also reduce reporting bias, a well-recognized issue in clinical research, which leads to underrepresentation of negative research findings.[30]

Definition of Priorities Help Align Research With Patient Needs

The James Lind Alliance (JLA) is an organization supporting the definition of research priorities[31] by mediating "Priority Setting Partnerships" (PSP), which aim to involve multiple

stakeholders, including those affected by the condition, their carers, and health professionals.

The significance of these standards is referenced by funding and regulatory bodies, such as the National Institute of Health Research (NIHR) UK, the Food and Drug Administration (FDA) USA, and the European Medicines Agency (EMA), who now seek assurances that proposed studies comply with such policy.[30]

*RECODE-DCM (*RE*search Objectives and* C*ommon* D*ata* E*lements for* D*egenerative* C*ervical* M*yelopathy)*

RECODE-DCM aims to reduce research wastage within the field of DCM by using a multi-stakeholder partnership to define the DCM research priorities, to develop a minimum dataset for DCM clinical studies, and confirm a definition of DCM suitable for establishment of a MeSH index term.

The natural evolution of DCM is unpredictable, and current treatments do not alter the underlying degenerative processes. Spinal cord compression may reoccur in individuals who have undergone surgery[1]; consequently, recent international guidelines[10] advocate lifelong surveillance for all patients with DCM. However, the assessments suitable and necessary for follow-up have not been defined. Similarly, benchmarks for audit, to ensure effective practice, have not been established. It is anticipated that the principal findings of RECODE-DCM can be used to make such recommendations. As a secondary objective, RECODE-DCM therefore aims to support clinical practice, by defining clinically relevant subsets of CMEs for clinical audit and clinical surveillance.

Methods

RECODE-DCM seeks to bring together stakeholders with lived or professional experience from all phases of DCM clinical care, including diagnosis and work-up, surgical treatment, nonoperative treatment, rehabilitation, and long-term follow up in order to establish a COS, CDE, CMS, and PSP for use in DCM clinical research and routine practice. The key objectives are as follows.

1. To achieve consensus between key stakeholder groups on the choice and definition of the umbrella term specific to this condition (index term)
2. To establish the top 10 research uncertainties (PSP)
3. To determine which outcomes are applicable and relevant for use in clinical efficacy studies of patients with a diagnosis (COS)
4. To determine which additional data elements are required for the robust interpretation of outcomes (CDE)
5. To determine how to measure agreed data points (CMS)

On this basis, the project also aims to make a pragmatic recommendation of which data points and measurement tools should be used in routine care to enable clinical audit and DCM clinical surveillance. The challenge will be ensuring a valid and comprehensive set, easily deliverable in routine care.

Table 2. Route to Consensus.

Consensus Processes	Consensus Stages/Tools
Index term	• Delphi
Core Outcome Set (COS)	• Systematic review + Qualitative interviews • Delphi • Consensus meeting
Common Data Elements (CDE)	• Systematic review • Delphi • Consensus meeting
Priority Setting Partnership (PSP)	• Delphi • Consensus meeting
Core Measurement Set (CMS)	• Systematic review (COSMIN) • Consensus meeting
Clinical Subsets, for Audit and Surveillance	• Consensus Meeting

The overall delivery of the project will be overseen by a steering group, who will meet at least twice a year in addition to interim correspondence. Each meeting will include at least 2 people with lived experience and 4 professionals present to be considered quorate. Where a steering group member is unable to attend a meeting, decisions made at a quorate meeting will be respected. The day-to-day administration of RECODE-DCM will be overseen by a subcommittee, referred to as the management group. These groups will ensure representation from those with lived and professional experience of DCM, and in addition the steering group will have representation from the identified key professional subgroups. This process is registered with the COMET and JLA initiatives.[32]

The recommendations of supporting organizations, such as NINDS, OMERACT, COMET, and JLA, alongside the reported experience of completed processes have been incorporated into the following protocol.

RECODE-DCM can therefore be considered as a number of different, but interlinked, work streams (Table 2). The index term will be established using a Delphi process. The PSP will use the Delphi process to inform a final and separate, face-to-face consensus meeting. The COS will be established on the basis of systematic reviews and qualitative interview work to inform an online Delphi process and final face-to-face consensus meeting. Similarly, the CDE will be established using systematic reviews to inform an online Delphi process and a final face-to-face consensus meeting. The CMS will be established using systematic reviews and the final COS, at a face-to-face consensus meeting. Based on the findings of these phases, the steering group will produce a pragmatic, distilled version or versions of the COS/CDE for use in clinical audit and clinical surveillance.

We will streamline the process into 4 phases (Figure 1): Phase 1 will consist of preliminary work, including a systematic review and qualitative interviews for the COS and CDE. In Phase 2, the Delphi process will take place. Phase 3 will incorporate the consensus meetings, and a final Phase 4 will monitor

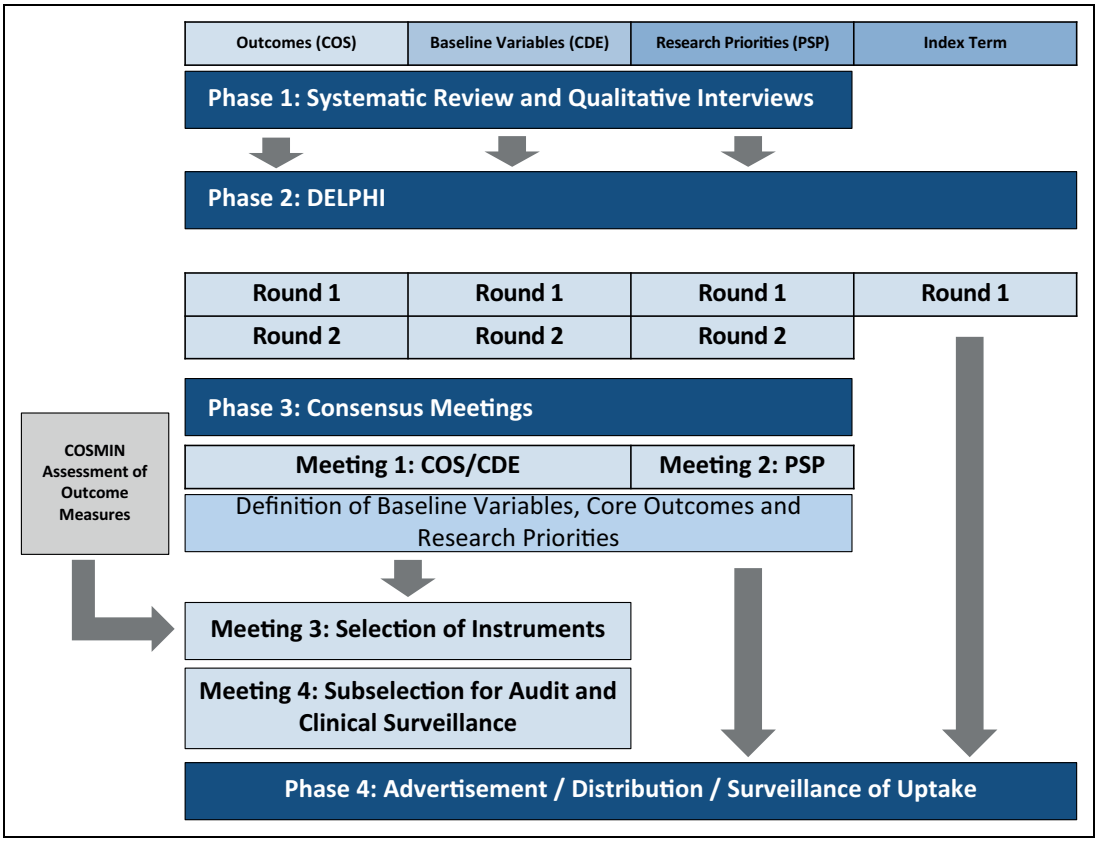

Figure 1. Structure of RECODE-DCM.
RECODE DCM will be undertaken in 4 phases. Existing systematic reviews (Phase 1) will inform a Delphi consensus process (Phase 2), which in turn will inform a final consensus meeting (Phase 3). It is anticipated the index term can be confirmed using the Delphi process alone. Phase 4 is the dissemination of findings.

and promote the dissemination and use of the eventual recommendations.

RECODE-DCM Work Streams

Each work stream will be discussed in turn. The components are outlined in Table 2. Concepts specific to multiple processes, such as the recruitment to and administration of the Delphi process or consensus meetings, are outlined subsequently.

1. Definition of an Index Term

The index term will be established using the online Delphi. A definition of DCM, developed by the steering group, will be presented to stakeholders. Stakeholders will have the option to approve or disagree with the definition. Those who disagree will be required to provide their reasoning, including definition amendments or alternative terms. If agreement is not reached, further rounds will follow.

2. Definition of research priorities: The Priority Setting Partnership (PSP)

The PSP sets out to establish the research uncertainties for DCM. There is no limitation on the type of DCM patient or phase of care. It will be established using an online Delphi process and a final face-to-face consensus meeting. This will be overseen by a JLA advisor.

Delphi. Round 1: Stakeholders will be asked to list their research priorities and include a justification for their reasoning. To help prompt respondent reflection, priorities will be sought in relation to the following themes: diagnosis, treatment, long-term care and other. There will be no limit on the number of uncertainties that can be submitted.

Data Processing: The results will then be processed. First, research uncertainties will be grouped thematically, to identify and remove duplicates. The unique uncertainties will then be processed using the JLA Data Management Template, to identify if they are true uncertainties (ie, not already answered through systematic review and termed "unrecognized knowns") and refine the information provided into an indicative (summary) question. This information will then be reviewed by the PSP steering group, where out of scope suggestions will be removed from the process and indicative questions refined as applicable. Where possible, out of scope uncertainties will be addressed separately, for example, through dissemination to relevant organizations, or separate research studies. It is intended a maximum of 60 uncertainties

will be presented in the second round of the Delphi. If more than 60 have been generated, this will be refined by the steering group, prioritizing those specific uncertainties, or uncertainties within themes, raised in round 1, overall and by stakeholder group.

Round 2: Following the collation and refinement, the research uncertainties, now in the form of indicative questions, will be re-presented to stakeholders, who will be asked to select their top 10. Research uncertainties will be randomized to prevent ordering bias.

Data Processing: The 20 to 30 research uncertainties most frequently included in a top 10 will be taken forward to the consensus meeting. Subgroup analysis, per stakeholder group, and using GRADE ratings, will be undertaken to identify any popular uncertainties not yet included, for example, those prevalent among individuals with lived experience, but not professionals. The steering group will review this data and the final list of uncertainties for inclusion in the final consensus meeting.

PSP Consensus Meeting: "Priority Setting Workshop". A face to face consensus meeting will be held and facilitated by JLA advisors, in order to select the final top 10 research priorities. The complete audit trail from original data, to final indicative uncertainties, will be kept and made publicly available on the JLA website.

3. Definition of a Core Outcomes Set (COS)

The COS is primarily intended for use in clinical efficacy studies of health interventions for use in DCM care. It will be established using systematic reviews and qualitative interview work to inform an online Delphi process and a final face-to-face consensus meeting.

Systematic Review. A systematic review of outcome reporting in DCM has already been conducted[18]; in short a broad search of MEDLINE and EMBASE, using the search strategy "Cervical" AND "Myelopathy" was undertaken for prospective clinical trials of more than 50 patients, and retrospective clinical trials of more than 200 patients, between the years of 1995 and 2015, assessing DCM exclusively. The reported outcomes were collated and presented with reference to their frequency and chosen measurement instrument. The author group categorized the reported outcomes by discussion and mutual agreement, into the following domains: function, pain, complications, quality of life, imaging and other.

Qualitative Interviews. Individuals with DCM and their caregivers will be invited to attend a patient and public involvement day, hosted at the University of Cambridge. Sufferers and their caregivers will participate in separate small group workshops, facilitated by an independent researcher experienced in qualitative research, to ascertain the outcomes of relevance to them. The groups will then be merged, and the findings from these separate workshops shared. The concept of outcome domains will then be outlined, and the combined group tasked with developing a category system for their defined outcomes. All interviews will be audio-recorded and transcribed for analysis.

Delphi. Domains identified by the systematic review and from the sufferer and supporter workshop will be reviewed by 2 researchers and someone with lived experience, to define the key grouping themes. Outcomes identified from the systematic review, and through content analysis of audio transcripts, will then be mapped to a domain, having removed duplicate or overlapping terms. Where there is uncertainty over relevance or duplication, terms will be discussed among the project management group, including a least one representative with lived experience and a health care professional. Outcomes will then be put forward into a 2-round online Delphi. These will be described using both lay and medical terminology, after having been piloted among a small working group involving both those with lived and professional experience.

Round 1: Participants within the COS Delphi will initially be introduced to the process using plain English summaries, available from COMET. Stakeholders will be presented with the list of outcomes, grouped within each predefined outcome domain and randomized to prevent ordering bias. GRADE rating will be completed. Stakeholders will be offered the opportunity to explain their reasoning and suggest other outcomes. New outcomes will be reviewed by the project management group, and if not already represented and within scope, will be coded. Out of scope suggestions will be removed from the process but retained separately and addressed as appropriate, for example, via future studies, quality control projects, or dissemination to relevant organizations.

Round 2: Stakeholders will then complete the survey again, for variables without consensus or newly suggested outcomes, including feedback from round 1. Specifically, they will be able to review their scores: overall scores and score per category of stakeholder for outcomes presented in the first round. Any explanatory statements given in round 1 will be summarized and reported. Outcomes will then be rated using the GRADE system.

COS Delphi: Definition of Consensus. Outcomes meeting the Delphi consensus criteria (Table 3) will be included in the COS. Outcomes meeting the definition for exclusion will be removed, and the remaining outcomes will be taken forward to the consensus meeting. Variables can be included directly from the results of round 1, but only excluded after round 2 of the Delphi process.

COS Consensus Meeting. Outcomes not yet included or excluded will be reviewed at a face-to-face consensus meeting. Each outcome will be reviewed in turn, with the feedback results from round 2 of the Delphi presented to participants for reference. Following discussion, participants will vote for inclusion, using the same GRADE profiling and consensus criteria (Table 3). If consensus for inclusion or exclusion is not established,

Table 3. A Priori Consensus Definitions[a].

Definition			
"Consensus In," one of:	(1) ≥70% score 7-9 and ≤15% score 1-3 (2) ≥90% score 7-9 within a single stakeholder group	AND	≥50% score 7-9 per stakeholder group
"Consensus Out"	≥70% score 1-3 and ≤15% score 7-9	AND	≥50% score 1-3 per stakeholder group
"No Consensus"	Neither of the above criteria are met		

[a] "Consensus In" will be described as follows: (1) ≥70% score 7 to 9 and ≤15% score 1 to 3, with ≥50% score 7 to 9 per stakeholder group; (2) Or ≥90% score 7 to 9 for one stakeholder group (those with lived experience or health care professionals). "Consensus out" will be defined as ≤15% score 7 to 9 and ≥70% score 1 to 3, with ≤50% score 7 to 9 per stakeholder group.

further discussion will follow, and a second round of voting will occur. For the second round, a threshold for inclusion of ≥60% score 7 to 9 and ≤20% score 1 to 3 will be set. If consensus is not reached after 2 rounds, the outcome will not be included in the COS.

The overall objective is to develop a COS with 10 or fewer outcomes, with at least one outcome among the core areas of adverse events, life impact, and pathophysiological manifestations. These core areas were chosen as relevant to DCM from the care areas defined by OMERACT.[33] If the a priori definition leads to the inclusion of too many outcomes, a nominal group technique will also be used to refine the list of outcomes, to establish an overall top 5, and a top 2 to 3 for professionals and those with lived experience.

4. Definition of Common Data Elements (CDE)

The CDE is primarily intended for use in clinical efficacy studies of health interventions for use in DCM care. It will be established using systematic reviews to inform an online Delphi process and final face-to-face consensus meeting. The systematic review work has been completed.

Systematic Review. A systematic review of baseline reporting in DCM clinical trials has been completed, using the aforementioned systematic search strategy.[22] The baseline reporting of outcome measures will be excluded, as these will be captured by the COS; CONSORT statements require outcome measures to be reported before and after intervention.[34] The remainder will be used to inform the Delphi process and referred to as data elements. These will be arranged into convenient subgroups, as defined by the project management group.

Delphi. Round 1: Participants within the CDE Delphi will initially be introduced to the process using plain English summaries. Stakeholders will be presented with the list of data elements, grouped as outlined above, randomized to prevent ordering bias. Stakeholders will be asked to consider whether or not a data element is essential for the evaluation of a DCM patient in order to make a decision as to the appropriate treatment. GRADE rating will be completed. Stakeholders will be offered the opportunity to explain their reasoning and suggest other data elements not listed.

New data elements will be reviewed by at least 2 members of the research team, and coded if not already represented and within scope.

Identified data elements will be cross-referenced with the existing literature for their significance in outcome interpretation, using references such as the recently updated systematic reviews by Tetreault et al on prognostic factors in DCM care[21] or disease progression.[35] Based on the literature, and following discussion among the management group, each data element will be assigned a certainty rating, as established by GRADE.[36]

Round 2: Stakeholders will then complete the survey again, for identified data elements, including feedback from round 1. Specifically, they will be able to review their scores, overall scores, and score per category of stakeholder for each data element in the first round. They will also be presented with a certainty rating, if such literature has been identified and a rating assigned. Any explanatory statements given in round 1 will be summarized and reported. Elements will then be rated using the GRADE system.

CDE Delphi: Definition of Consensus. Data elements with moderate or high certainty of influencing outcome interpretation will be included in the CDE. Data elements meeting the definition for exclusion will be removed, and the remaining elements will be taken forward to the consensus meeting. Consensus will be assessed at the end of round 2 only.

CDE Consensus Meeting. Data elements not yet included or excluded will be reviewed at a face-to-face consensus meeting. Each element will be reviewed in turn, with the feedback results from round 2 of the Delphi presented to participants for reference. Following discussion, participants will vote for inclusion, using the same GRADE profiling and consensus criteria. If consensus for inclusion or exclusion is not established, the data element will not be included in the CDE, that is, only one round of voting will take place for data elements.

5. Definition of a Core Measurement Set (CMS) and Subsets for Clinical Practice

Systematic Review. A synthesis of relevant measurement instruments will be compiled. This will build on previous work[18,37] and will include an assessment of their measurement

properties, as per the COSMIN criteria, for use in DCM. The COSMIN search filter,[38] including our own filter for DCM research,[24] will be used to facilitate this process.

CMS Consensus Meeting. This information will be presented to the steering group in a subsequent and separate meeting, although additional meetings may be required. The objective of this meeting will be to select the most appropriate instrument(s) for data points included in the CDE and COS. A secondary objective of this project is to develop a refined list of data points from the CDE and COS suitable for clinical audit and surveillance. Clearly this in itself could be a separate multistage consensus process; however, pragmatically this is not possible. Therefore, it will be left to the steering group to establish this shortlist. Their decision will be informed by the final CDE and COS, including the quantitative data from the Delphi process and Consensus Meeting.

The Delphi Process

To improve efficiency, and reduce attrition among stakeholders, participants will be recruited to a single Delphi process. However, in order to reduce the burden on respondents, and avoid confusion, participants will ideally be randomized to 1 of 3 parallel processes: CDE, COS, and PSP. All strata will include assessment of the index term.

Stakeholders

Currently, there is no standard method for Delphi recruitment nor a required stakeholder number. A fair representation of all parties involved, worldwide, is thought to be key to deriving an applicable and transferable consensus. This includes involvement of participants from low- and middle-income countries. The significance of patient involvement has already been outlined, and on that basis, we will aim for a 1:1 ratio of participants with lived experience to professionals.

Our recent diagnostic pathway analysis for the East of England, United Kingdom, identified the key professional groups involved in providing DCM care[39]: the majority (98%) of patients underwent initial consultation with a general practitioner, before referral to secondary care. Secondary care assessment was mainly via neurology (45%) or a physiotherapy triage service (45%), although other specialties including rheumatology, geriatric medicine, and acute medicine were involved. Most (98%) of patients received a treatment plan from a spinal surgeon. Spinal surgeons play a key role in the field of DCM, as the mainstay of treatment guidelines recommend all patients have a spinal surgery opinion,[10] moreover currently they dominate the clinical research field.[14] On this basis, within the professional group we will aim for a 1:1 ratio between spinal surgeons and other professionals (eg, other clinicians, allied health professionals, and researchers).

Sampling

A dedicated study web page will be created, as both an information resource related to the study and the single registration point for participation. This information will outline the role of a stakeholder, including the expected commitment and significance of participation in all Delphi Rounds. Registration will require respondents to provide selected demographics, including age, gender, geographic location, and stakeholder group. Respondents will also complete a conflict of interest disclosure.[40] The action of registration may favor continued participation,[41] but will also allow live assessment of recruitment strategies and adaptation of strategies if insufficient representation among subgroups is found.

Principally, patients will be identified through Myelopathy.org, a DCM charity and online support community, supported with Google Adwords advertising. We have previously utilized such strategies for the recruitment of DCM sufferers to online surveys. This approach also enables Google Analytics to be used to ascertain efficacy.[42]

For each professional subgroup national or international representative bodies will be approached to advertise participation. As a project conducted in English, strategies will focus on English-speaking countries, specifically America, Canada, Australia, New Zealand, Ireland, and the United Kingdom. However, some organizations have a broader reach, for example, the AO Foundation or Cervical Spine Research Society, and recruitment will extend beyond these counties. In addition, key academic influencers will be identified through citation analysis of DCM studies published over the last 5 years, with approaches made to authors having published more than 3 DCM articles in this period. All registered participants will be encouraged to promote the project among their colleagues or patients.

Recruitment strategies will principally employ email or social media. Piloted, promotional material will be used to support these recruitment strategies. There are no recommendations for set sample sizes to include in a Delphi study. Instead a pragmatic approach will be taken, prioritizing balance across stakeholder groups.

Administration

Recruited stakeholders will be divided into their matching groups, namely, those with lived experience, spinal surgeons, and other professionals. The sample size and representation will be reviewed by the steering group. Ideally, stratified randomization will then be undertaken, to ensure 3 equal groups meeting the predefined criteria.[43] Respondents will remain in the same strata, with no crossover. However, if it is felt that there is insufficient representation to allow 3 parallel Delphi processes, the number of strata may be reduced.

Strategies identified from the literature to reduce attrition between rounds, will be used, including pre-registration, use of plain and clear language, regular updates, transparency regarding time commitments, and personalized reminders.[44,45]

Additionally, respondents completing all Delphi rounds will receive a personalized certificate of participation and listing as a collaborator to the RECODE-DCM study.[46]

Each list of items within the various Delphi surveys will be accompanied by plain language descriptions, grouped into categories and organized randomly at a category level and item level. All items and descriptions will be reviewed by the steering group and may be piloted or externally reviewed to encourage development of survey language that all stakeholder groups will equally comprehend.

Assessment of each item will largely be using the GRADE process[47]; a 9-point Likert scale where a score of 1 is least important and 9 most important. On occasion stakeholders will be able to make suggestions or justify their answers as free text. The a priori consensus definition is defined in Table 3.

The ambition is to complete the Delphi survey as outlined, although if insufficient agreement has been made to facilitate a consensus meeting this may be extended.

Sensitivity Analysis

The respondent rankings and choices will be analyzed by subgroup to explore whether subgroups favored certain selections. While the information will not be used within the eDelphi, at the discretion of the steering group, these findings will be presented at the consensus meeting, to support decision making.

The Consensus Meetings

An international and multidisciplinary spine conference will provide the platform for a face-to-face consensus meeting. In addition to health care professionals and researchers involved in DCM, patient and carer stakeholders will be invited. The aim is to have a sample that is representative of the larger consensus group, both in stakeholder makeup but also prioritizing individuals who have provided responses approximating the average opinion from the Delphi process. Invitations to the meeting will be orchestrated to ensure fair representation of expertise and demographic but will be weighted to the location of the conference for convenience. Meetings will be facilitated by those with trained experience, specifically for the PSP consensus meeting which will be performed by JLA advisors.

Ethics and Dissemination

Ethical approval for the qualitative interviews, Delphi process, and consensus meetings will be sought.

Myelopathy.org, an international charity and online platform for those with the condition, carers, and professionals interested in DCM, and AOSpine will host the eventual consensus guidelines. They will act as a portal for supporting information and assistance (if required). The COMET and JLA databases will also be updated, and traditional journal publication sought. A strategic dissemination plan will be developed in concert with a health care public relations expert (ES). Following a quality improvement strategy, methods of advertisement and distribution will be evaluated periodically and adapted over a 5-year period to track and accelerate uptake of the guidance. Further professional bodies and funding partners will also be involved.

Discussion

The Delphi Approach Is a Proven Way of Reaching Multi-Stakeholder Consensus

Consensus standards have been reached by a variety of methods, ranging from stand-alone meetings to more complex, multifaceted approaches.[48] While there are some technical differences, both the aforementioned organizations advise a sequential Delphi process to inform a final face-to-face consensus meeting. The Delphi method is well established with regard to the development of consensus guidelines as it facilitates the refinement of multiple opinions into an accepted and applicable recommendation.[33,41] While a PSP has not previously been interwoven with a COS or CDE, their overlapping methodology and the challenges of bringing multi-stakeholder groups together offers an opportunity to meet both important objectives, more efficiently. This will also provide an opportunity to define an index term.

Ensuring Adequate Representation and Participation of Stakeholders

Adequate and balanced representation must be present at each stage; within the steering group, the online surveys and the final consensus meeting. Exactly what constitutes a balanced makeup is yet not defined.[49] This applies both to groups, but also the number of representatives per group and the overall weighting or proportions of each group. In the recent COS-STAD guidelines key stakeholder groups were identified as those who would use the CDE, health care professionals with experience of the condition and patients and their representatives.[49] The guidelines were not able to define this further, but it is recognized that the makeup will differ depending on the objectives, for example, a PSP for breast reconstruction had a large patient weighting that would seem logical as it is a largely "body image"–based outcome.[45]

Online Surveys Are Efficient Tools to Reach Stakeholders but Suffer From Attrition

The majority of information is collated and refined using online surveys. The advantage of this is efficient access to large number of individuals from across the globe. We have recently shown this in DCM.[42] However, particularly if sequential surveys are conducted, there is risk of attrition among participants, which can lead to an overestimation of stakeholder agreement.[41] There is little published research on strategies to reduce attrition within Delphi surveys but lessons from related processes may be applicable: a Cochrane Review of patient

recruitment to one-off electronic questionnaires identified a number of factors which improved response rates, including the benefit of short surveys.[50] How transferable these findings are to a serial process is unclear. Retention among randomized controlled trial patients may be more pertinent, but findings of a Cochrane Review again are not specific to an electronic process.[51] Alternative strategies specific to consensus processes have sought to introduce efficiencies to reduce attrition. For example in CDEs systematic reviews are often used to inform the core domains, and the Delphi process is employed to identify the measurement instruments.[52,53] With regard to PSPs, the JLA recommends the use of the steering group to refine the number of research uncertainties before each stage.

Commonly, a degree of pragmatism is accepted to ensure the project is deliverable,[45] but the limitations of adaptations must be noted. The steering group offers important oversight of the process, and therefore must equally offer balanced representation to prevent bias.

Conclusion

We propose an ambitious and comprehensive protocol, designed to deliver recommendations that will shape the direction and improve the efficiency of future DCM research. For the first time, RECODE-DCM will integrate consensus processes to establish an index term, COS, CDE, and PSP. Our aim is to improve the use of future resources to deliver efficient research by using patient priorities to inform the scope of future DCM research activities. The consistent use of a CDE in DCM clinical studies, audit, and clinical surveillance will facilitate pooled analysis of future data and, ultimately, a deeper understanding of DCM.

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